

imagination at work



# Renewable Energy Systems

**- GE Technology and  
Global Markets**

*James Maughan*

*GE Power Systems*

*GE Global Research*



# The New GE



**13 Businesses ... Strong and Diverse**



# GE Power Systems

- '03 Sales \$19 Billion
- Global Resources
  - 35,000+ Employees
  - Equipment and Service
  - Leading Technology
  - Rapid Growth in New Areas



# 7FA Gas Turbine – GEPS Growth Engine

Rotor cracking  
Resolution

Flashback  
Resolution

Low Emissions  
Combustion

Monitoring and  
Diagnostics



Robotic  
Repair

Brush Seals

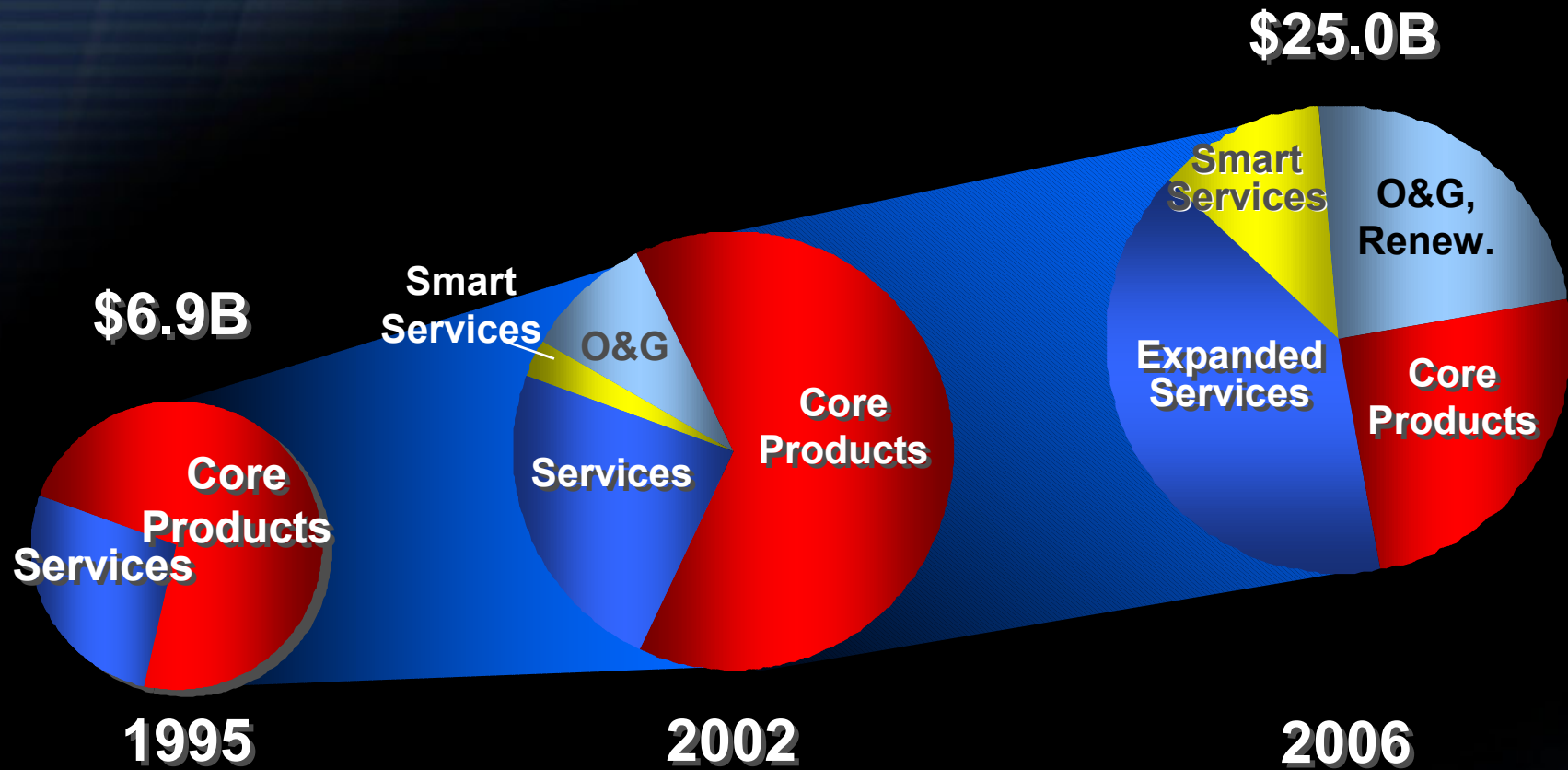
Single Crystal  
Casting

Thermal Barrier  
Coatings

High Temperature  
Alloys

**Emissions, Reliability, Performance: Ready For The Market**

# GEPS Transformation

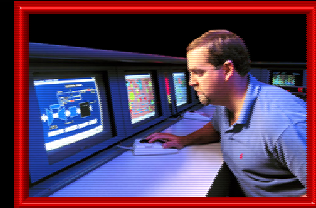
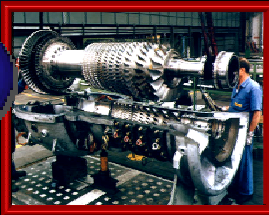


**Power Gen “Bubble” Fuels New Growth**



# Current View – GE Power Systems

**O&G,  
Renewables**



**Power  
Generation**

**Management,  
Services**

**World's Best Turbines...And More**

# GE Power Systems Businesses

**\$7.3**

**Products**

**\$6.7**

**Services**

**\$2.8**

**Oil&Gas**

**\$1.1**

**Wind**

**\$1.1**

**Aero**

**\$0.9**

**Nuclear**

**\$0.4**

**Hydro**

**\$19B Total Revenue**

- Tur
- Ge
- Di

- Contra
- Install
- Inspe
- Repair
- Equip
- Asset

- Mech
- Comp
- Centr
- Refin
- Pipeli
- Inspe

- Wind Turbin (900kW – 3.5MW)
  - Land-B
  - Offsho
- Full Range Services

- Turbines (5 – 50MW)
- Service for GE and Non-GE Engines
- Upgrades
- Equipment Leasing

- Advanced Boiling Water Reactors
- Plant Operating Services
- Advanced Nuclear Fuel

- Turbines (45 – 800MW)
- Generators (10 – 800mVA)
- Valves (65MM – 10M Diameter)

# GE Global Research

**Founded in 1900 in  
Schenectady, NY  
by Charles Steinmetz**

2003



c. 1900



**One of the world's largest  
and most diversified  
industrial laboratories**

**Cornerstone of GE's Commitment to Technology**



# Global Research Locations

Schenectady, NY



Bangalore, India

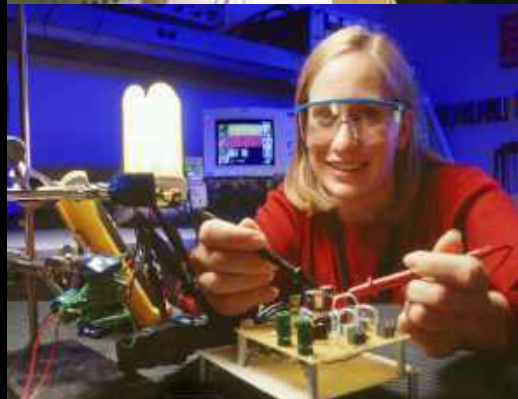
Munich, Germany

Shanghai, China

**Worldwide Talent and Technology**

# Research Areas

Diverse, World-Class  
Scientists and Engineers



- **GE Technologists**
  - **2500+ Worldwide**
  - **\$350MM Annual Spend**
  - **More Than 1,400 Patents Issued in 2002**
- **Short Term**
- **Next Gen**
- **Emerging**
  - **Nano**
  - **Molecular**
  - **PDE**
  - **...**



# GEPS Research Highlights



## Gas Turbine

- Combustion, brush and abradable seals, aero, alloys, repairs, sensors, optimization, pulsed detonation, fluidics...



## Steam Turbine

- Hybrid last stage bucket, HEAT designs, stationary CFD



## Generator

- Superconducting generator, cooling technology, acoustics, stator modeling, diagnostics

## Aero Energy Products

- Gas recip, alternate fuels, microturbines, recip

## GE Nuclear

- Life extension, new concepts

## Hydro

- Coatings, uprates, CFD

## Wind

- Offshore, blades, controls, drive train, manufacturing

## Oil and Gas

- pipeline sensors, subsea, catalytic combustion

## Photovoltaics

- Modules, organics

## Fuel Cells

- Solid oxides, hybrids

## Hydrogen

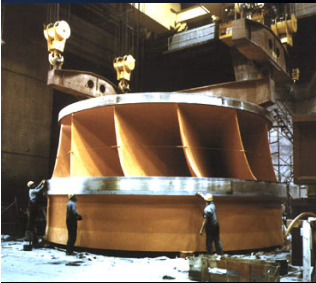
- Reforming storage



# GE Renewables Summary

## Hydro Power

- \$400MM GE business
- Established high efficiency systems
- Growth in S. America, Asia
- Research on cavitation. coatings, performance



## Wind

- New GE business, May '02
- Growth to 1.1B sales in '03
- 1.5 and 3.6MW designs
- Competitive cost of electricity
- Cost, reliability, performance improvements
- Moving to offshore technology



## Biomass

- 20% of GE Jenbacher business
- Gasification most promising sector
- Compatible with high efficiency reciprocating gensets and microturbines
- Advanced research on bio-enabled gasification



## Photovoltaics

- New GE growth area
- Opportunity in retail markets
- Potential similar to Wind
- Focus on module and system integration for cost
- Research on organic PV

